Remarks:

This amendment is submitted in an earnest effort to advance this case to issue without delay.

The specification has been amended to eliminate some minor obvious errors, to inert the required PCT cross-reference paragraph, to eliminate the references to the claims, and to insert US-style headings. No new matter whatsoever has been added.

The claims have been completely rewritten and replaced with a set of 25 claims, including five independent claims. A PTO-2038 for two extra independent claims is enclosed herewith.

Before going into a detailed discussion of the art, it is important to note that in patients with neurological or psychiatric disorders, such as Morbus Parkinson, essential tremor, dystony or obsessive disorders, certain neuron populations in the brain become pathologically active, for example, excessively synchronous in their activity. In this case a large number of neurons generate action potentials synchronously and fire predominantly synchronously. With healthy individuals, by contrast, the neurons fire qualitatively differently, for example in an uncontrolled, non-synchronous manner.

One object of the invention is to counteract a pathologically created synchronization in a neuron population by

desynchronization. The invention is based on the discovery that excessively synchronous neurons showing a pathological neuronal rhythmic activity can be influenced by splitting the neuron population in at least two subpopulations having different phases in their neuronal activity.

For this purpose, a plurality of electrodes is introduced into the brain region that causes the formation of the pathological pattern. Before the stimulation is started, a great number of the neurons to be stimulated fire synchronously and thus have a common phase in their neuronal activity. During stimulation, each of the electrodes outputs in its vicinity stimulation signals that reset or reverse the phase of the neuronal activity of the neurons stimulated by the respective electrode. The neurons stimulated by the respective electrode still fire synchronously shortly after the stimulation, however these neurons have a common phase that is different from the phases of the other neurons. Neurons having the same phase form a so-called neuron subpopulation of the entire neuron population to be desynchronized.

The neuron population to be desynchronized is so influenced by the stimulation signals at different stimulation sites that the total neuron population to be desynchronized is split into several subpopulations. The neuronal activity within one subpopulation is still synchronous, but the phase of the synchronous neuronal activity differs for each subpopulation. Because of the pathologically created interaction between the neurons, the state created by this stimulation is unstable in the

subpopulations and the entire neuron population quickly approaches a state of complete desynchronization. The desired state of complete desynchronization is thus not present immediately after the application of a stimulation but typically develops over a short period of time.

The claims stand rejected under §102 in view of US 5,978,702 of Ward or US 7,174,213 of Pless.

US '702 of Ward concerns techniques using drugs and electrical stimulation for treating a neurological disorder (cf. abstract). Ward further suggest implanting one or more electrodes for electrically stimulating a predetermined stimulation site in the brain (cf. column 3, lines 24 to 27). However, Ward is silent regarding a phase reset or phase reversal of the stimulated neuron population. A person skilled in the art does not get any hint from Ward to apply stimulation signals to the stimulation sites that effect a phase shift within the stimulated neuron population.

It is also to be noted that the Examiner's position, that is that Ward also meets the limitation of subpopulations because it is stated in the specification on page 19, lines 19 to 22 that the entire neuron population to be desynchronized is subdivided into subpopulations if several stimulation sites are stimulated, is not correct (cf. page 4, paragraph 7 in the Office Action). The Examiner ignores the fact that the neuron population to be desynchronized is only subdivided into subpopulations if the stimulation signals effect a phase reset or phase reversal at the different stimulation sites. If, however, the stimulation at

different stimulation sites is carried out so that no phase reset or phase reversal occurs, the entire neuron population is not split into any subpopulation. Even worse, such stimulation may cause the opposite effect and may intensify the synchronous activity of the stimulated neuron population.

The same is true for US '213 82 of Pless, which describes a neurostimulator that provides various stimulation signals for brain stimulation (d. FIGS. 1 and 3 to 11). In contrast to the invention, Pless suggests stimulating neuron populations in a qualitatively different manner. With the desynchronization method described by Pless, the neuron population to be desynchronized is brought directly into a desynchronized state. For that, a relatively large amount of energy needs to be introduced into the neuron population. The device and method according to the invention by contrast first splits the neuron population into several subpopulations by introducing one or more phase shifts into the neuron population. Once the neuron population to be desynchronized is divided into subpopulations, the pathologically increased interaction between the neurons can contribute to the desynchronization. In this case one utilizes the surprising presence of a self organization process of the neuron population, which causes the pathological synchronization, to assist in eliminating it. In other words, the energy of the system itself is thereby utilized to produce a therapeutic effect so that less energy needs to be introduced into the neuron population from external when compared to the stimulation suggested by Pless.

In summary, the subject matters of the independent claims 53, 58 and 68 are neither known from nor suggested by the available prior art. A rejection under §102 is impossible because critical features of the invention, namely splitting a neuron group into subpopulations and stimulating them with offset signals, is not shown in these references, and a §103 rejection is impossible because there is no phase or temporal shift of stimulation signals for different subpopulations suggested in either reference.

Independent claims 64 and 74 are focused on a further aspect of the invention. In general, treatment results are obtained if the phases of the stimulated subpopulations are at least partly shifted relative to one other (cf. page 20, lines 17 to 21 in the specification). For this purpose it is sufficient to apply phase-resetting or phase-reversing stimulation signals to different stimulation sites that are temporarily shifted relative to one other. The treatment results are even better as the phase shift produced approaches an equidistant phase shift. According to independent claims 64 and 74, the time shift, in particular phase shift, between two successive stimulation signals that are applied to different stimulation sites and that are responsible for a phase reset or phase reversal, substantially amounts to a quotient T/N, where T is the period duration of the pathologically oscillatory neuronal activity and N is the number of electrodes (or stimulation sites). Neither Ward nor Pless teaches such a delay between successive stimulation signals. Therefore the references to Ward and Pless would not provoke the reader to try to desynchronize a

pathologically active neuron population in the way claimed in claims 64 and 74. No §102 or §103 rejection of these claims is possible either.

For these reasons all the claims in the case are in condition for allowance. Notice to that effect is earnestly solicited.

If only minor problems that could be corrected by means of a telephone conference stand in the way of allowance of this case, the examiner is invited to call the undersigned to make the necessary corrections.

Respectfully submitted,
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